DOI: 10.22620/agrisci.2019.26.009

AGRICULTURAL INNOVATION SYSTEM: THE ROLE OF R&D IN BULGARIA

Dobri Dunchev, Rositsa Beluhova-Uzunova*

Agricultural University – Plovdiv

***E-mail: rosicab_uzunova@abv.bg**

Abstract

Innovations are considered as a key driver for economic growth and increased competitiveness. Investments in agricultural research and development could generate not only economic and social effects but also environmental benefits. The study aims to analyse of agricultural innovation system in Bulgaria and the linkages with agricultural R&D to formulate conclusions and recommendation for future development.

The paper presents some of the theoretical concepts of innovation systems and the role of R&D in the process. Comparative, historical and monographic methods of analysis are applied. The results indicate the low share of R&D expenditures in the national GPD. The share of agricultural R&D expenditure is declining and Bulgaria is lagging behind the EU-28 average level. Despite the high potential of Bulgarian agricultural innovation system, it is characterized by unclear priorities and lack of coordination. Several challenges should be addressed: improvement of public funding, human resources capacity building and cooperation between research and business are some of the main priorities for agricultural innovation system development and transformation.

Keywords: systems innovation approach, coordination and cooperation, knowledge transfer.

INTRODUCTION

Agricultural innovations are key drivers for productivity growth, increased competitiveness and sustainability. (Atanasov, Popova, 2010). On the other hand, they contribute to overcoming major challenges as climate change and resource scarcity. In the last century agricultural innovation perspective evolved and transformed.

Agricultural research and development (R&D) as part of the innovation process has undergone several changes in design, implementation and evaluation. In the 21st century, agriculture remains a key factor for poverty reduction, economic growth, and environmental sustainability in rural regions. Increasingly, agricultural R&D is expected to play a major role in the innovation process in rural areas.

The aim of the study is based on the analysis of the agricultural innovation system in Bulgaria and the linkages with agricultural R&D processes, to formulate conclusions and recommendation for future development.

MATERIALS AND METHODS

The paper presents some of the theoretical concepts of innovation systems and the role of R&D in the process. Comparative, historical and monographic methods of analysis are applied in the study.

The survey is based on data from Eurostat, National Statistical Institute and Ministry of agriculture, Food and Forestry.

RESULTS AND DISCUSSION

- **Theoretical background**

In the scientific literature, there are different definitions of innovation. The OECD and Eurostat define innovation as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations (OECD and Eurostat, 2005). The link between innovation and R&D is presented by Bean and Radford (2002). According to the authors, innovation is the economically successful use of the invention.

In the context of agricultural research, innovation covers the activities and processes associated with the production, distribution, adaptation, and use of new technical, institutional, organizational, and managerial knowledge and service delivery (Hall, Mytelka and Oyeyinka, 2005).

Smits et al. (2010) present two major perspectives on innovation policy: the systems of innovation approach and the macro-economic approach. Based on the macro-economic approach innovation is considered as a linear process from

research via R&D to commercial application. The systems of innovation perspective include a more complicated approach to innovation policy. Key component is the interaction between different stakeholders in the innovation process.

The macro-economic view is based on the work made by economists such as Ricardo, Marshall, Walras, Coase, Hayek and Friedman. On the other hand, another group of authors developed the systems of innovation approach: Schumpeter, Friedrich List, Ken Arrow and Oliver Williamson. (EU-SCAR, 2012)

Systems thinking is not new to agriculture (Anandajayasekeram, 2011). Number of different authors analyse the adoption and implementation of systems of innovation perspective (Biggs, 1989; Elliot, 2004; Elliott, 2008). Currently, the relationship between innovation, innovation policy and even innovation theory is seen as a learning perspective in a multi-stakeholder setting (Smits et al., 2010, p.7).

Definitions of the agricultural knowledge system (AKS) changed in parallel with the development of agriculture and the emerging global challenges. According to Leeuwis and Van den Ban (2004), the roots of the AKS concept can be found in the 1960s, in the priorities of the agricultural policy that tend to coordinate knowledge and innovation transfer to accelerate agricultural modernization.

Since the 1970s, international organizations as the OECD and the FAO present the concept of “agricultural knowledge and information systems” (AKIS). They define the AKIS as a system that seeks to encompass and influence the complexity of knowledge and innovation processes in the rural sphere. (OECD, 2013). The original formulation of AKIS described it as "a set of agricultural organizations and/or persons, and the links and interactions between them, engaged in the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilization of knowledge and information, with the purpose of working synergistically to support decision making, problem-solving and innovation in agriculture” (Röling and Engel, 1991). This concept develops and includes actors outside the research, education and advice sectors. (Klerkx and Leeuwis, 2009). Main features of an innovation system are the institutional infrastructure, funding mechanisms, network characteristics and market structure (Klein Woolthuis et al., 2005).

Agricultural Research (AR) focusses on national needs, while Agricultural Research for Development (ARD) is dedicated to collaboration with and in developing (European Commission, 2016). The links between research and innovation, the functioning of AKIS are relevant topics for both AR and ARD. As a result, the coordination between both is needed.

- **Agricultural innovation system in Bulgaria**

The Bulgarian research system is associated with low public funding in the transition period to the market economy. As in other transition countries, this process was accompanied by an "implosion" of the country's national R&D system. (Freeman, Soete, 1997). During the planned economy the public funding of R&D was provided through the allocation of resources from different Ministries. The old system is eliminated and new opportunities for private national and international firms to invest in research and innovation are created.

Bulgaria has internationally acknowledged expertise, which public funding was lost. The private investment is directed to Development rather than by Research and associated with global networks. Therefore the „implosion“ process in Bulgaria has more implication than in other transition economies and led to serious challenges.

The association to the EU is considered as the main opportunity for the institutes of the Bulgarian Academy of Sciences (BAS) and the Agricultural Academy (AA) and universities to benefit from participation in European research programs.

The results, however, show that Bulgaria is not prepared for the system of funding in the EU. The insufficient EU financial support in the field led to a lack of assurance in Bulgarian capacity for supporting and administering research and innovation (Hristov, 2011; Georgiev and Roycheva, 2017).

The national public research is moving with small steps forward, with most stakeholders putting their efforts in trying to maintain their level. By contrast, the international private sector is more interested in Bulgarian research and innovation (European Commission, 2015).

Bulgaria is reforming its innovation system and the new priorities, recommendation and actions are planned and included in the National Strategy for Development of Research 2020 and the Innovation Strategy for Smart Specialisation (ISSS).

In the agricultural sector, the Knowledge and Innovation System (AKIS) is formed by several different organization involved in the process of generating, transferring and implementing knowledge and innovation in agriculture.

In addition to the different types of farms and farmers` organizations, the system includes

also scientific institutes, universities, advisory service, private consultants, NGOs, processors and exporters of agricultural products, ministries, government agencies, local authorities, international organizations, etc.

Figure 1 presents the main actors in the Bulgarian AKIS. Based on the theory and practice, the traditional "linear" macro model (science-national advisory service-farmers) is replaced by the implementation of a new model.

The perspective is shifted to the systems of innovation approach, where the actors form different type (sectorial, regional, national, transnational) systems for 'joint' creation and transfer of knowledge and innovation. The main purpose is to meet the needs of farmers, rural communities and other actors in the food value chain.

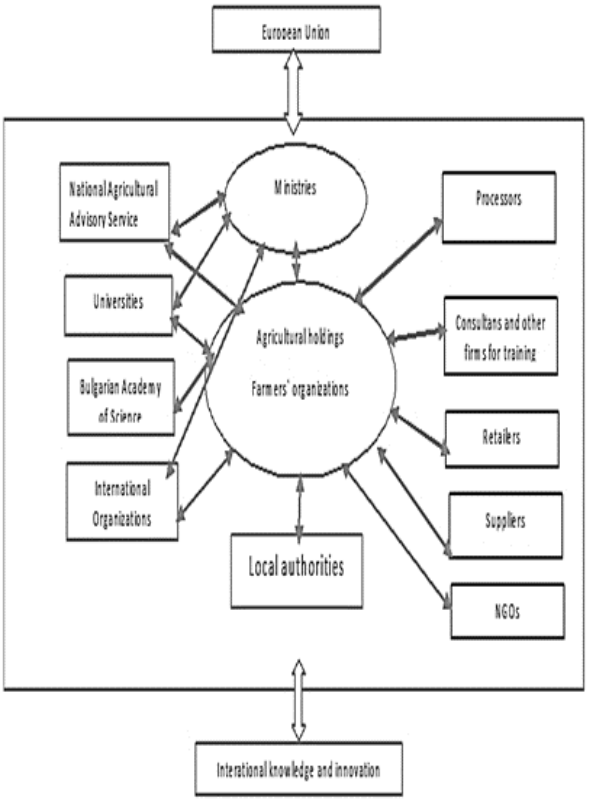

Fig. 1. *Main actors and linkages in the national System for knowledge and innovation in agriculture*

Source: Based on Bachev, Mihailova (2019)

In Bulgaria, there is not sufficient official statistical information for the status and the development of this system, the individual elements and linkages between the actors. Therefore the analysis and comparison with other Member-States are difficult (Bachev, Mihailova, 2019).

- **Trends in Bulgarian R&D in agriculture**

The EU is stimulating investments in innovation and development, to improve productivity and competitiveness in all sectors of the economy. The Europe 2020 strategy maintains a long-standing objective, namely, for the EU to devote 3.00% of gross domestic product (GDP) to R & D activities (EU, 2010).

Figure 2 represents the share of R&D expenditure in GPD in EU-28, Bulgaria and the countries with the highest and lowest level of expenditure.

According to Eurostat in the EU-28 gross domestic expenditure on R&D are EUR 317.1 billion or an average of EUR 620 of R&D expenditure per inhabitant. For the period 2007–2017 the indicator increases by 40%.

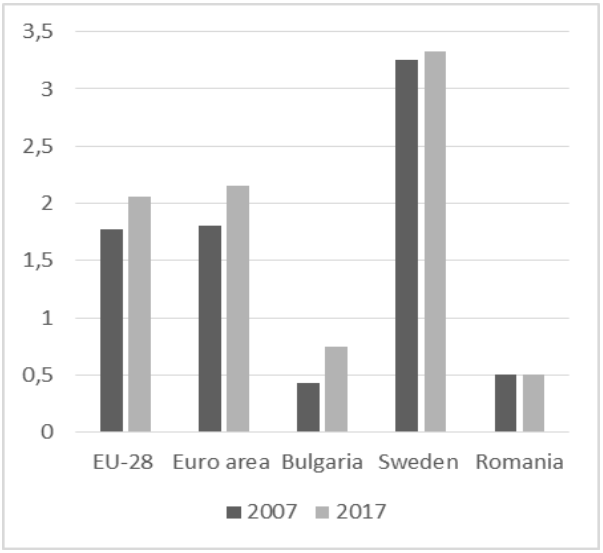

Fig. 2. *Gross domestic expenditure on R&D, 2007 and 2017 (%, relative to GDP)*

Source: Eurostat

Based on the Eurostat data the Member-States can be divided into three groups. In the first one are the countries with the highest R&D intensities in 2017 - Sweden (3.33%), followed by Austria (3.16%), Denmark (3.06%), Germany (3.02%), Finland (2.76 %) and Belgium (2.58%).

The other group is formed by countries with close to EU-28 average gross domestic expenditure on R&D. France, The Netherlands, the Czech Republic, Slovenia, The United Kingdom, Portugal, Italy and Hungary are with the R & D intensities in the range of 2,19% to 1,33%.

There are eight Member States with R & D expenditure below 1% of their GDP in 2017. Bulgaria is part of the third group with 0.75%. The

lowest R & D intensities is registered in Romania (0.50%), Latvia (0.51%) and Malta (0.55%).

For the period 2007–2017 the majority of the EU Member States registers increase in R & D intensities. There are six exceptions and in Finland is reported the highest decrease 0.59 percent points. By contrast, the biggest growth in R & D intensity is recorded in Austria and Belgium (0.7percent points), followed by Germany (0.57 percent points).

In Bulgaria, there is an increase of 0.32 percent points. It should be noted that in the country the share of R&D expenditures is low compared to the EU-28 average. The country is lagging far behind most of the Member-States. The problems during the transition and the slow adaption to the new approaches in the EU led to serious challenges related to the role of R&D in Bulgaria.

The main concern is how Bulgaria could reach the national target of 1.5% R&D intensity in 2020. This national target implies a dramatic increase in R&D over the next years, which is hardly possible.

The difference between the research investment in Bulgaria and other transition economies is substantial. Countries like Slovenia, the Czech Republic, Hungary or even Poland recover their research system. Bulgaria is in less favoured position compare to all those countries, except for Romania which had always a much lower research intensity economic structure.

Figure 3 shows other interesting indicators- Government support to agricultural research and development in Euro per inhabitant.

The data indicate significant variation among Member-states. The highest level of the support is in Ireland (22 EUR per inhabitant), while on the other range is Romania with 0.7 EUR per inhabitant. In Bulgaria, the government support to agricultural R&D is two times lower compare to EU-28 average.

The wide range of values in the different Member-States can be explained with the fact that the indicator shows only government support without private investments. There are countries, where the private sector plays a more important role in agricultural R&D than public support.

However, the results show that Bulgaria is below the EU-28 level and is overtaken by most of the other transition countries.

It should be noted that in the Bulgaria the government support plays a major role in the funding with around 80% (NSI,2019), which emphases the need of number of changes in the system to overcome the significant gap compare to other Member-states.

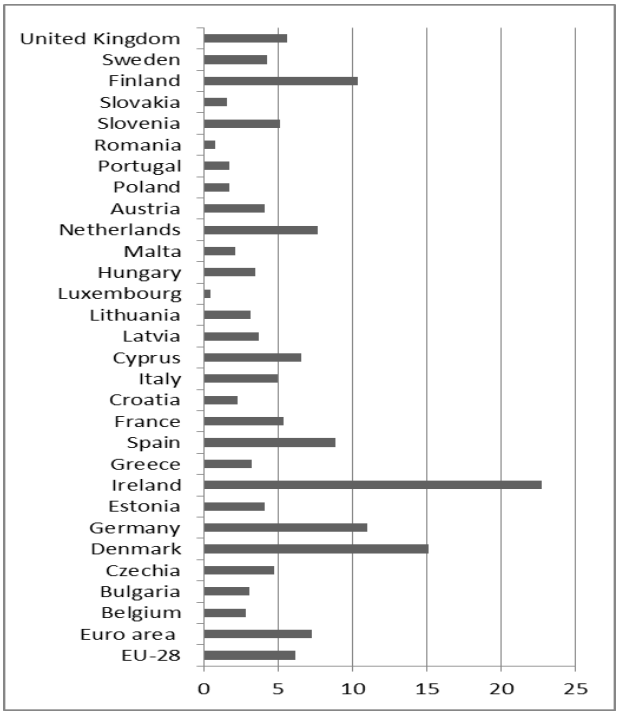

Fig. 3. *Government support to agricultural research and development in Euro per inhabitant, 2018*

Source: Eurostat, NSI

Another important indicator is the share of agricultural R&D in generated gross value added in the sector. The results in Bulgaria are compared to EU-28 and Eurozone (Figure 4).

The results show that after the EU membership, the share of R&D expenditures in agricultural GVA is seriously reduced in Bulgaria. In 2014, this indicator is 2.3 times lower compere to 2007. In the past few years, the share is increasing although it is below 2009 levels. The dynamics can be explained with the global economic and financial crisis, but also with the challenges in Bulgarian innovation system.

The trends in Bulgaria are in parallel with the process in EU-28 and Euro area. The indicator is declining although there are not many variations compare to Bulgarian tendencies. The reduction in EU-28 in percent point is 0.4 for the period 2009–2017. In Bulgaria, the registered decrease is 0.32 percent points. However, the share of R&D expenditure in GVA in Bulgaria is below the EU average.

In most of the Member States (Estonia, Spain, Lithuania, Hungary, Portugal) the share of expenditure for agricultural R&D in the gross value added of the sector is declined but exceeds the level in Bulgaria. In another group of countries such

as Croatia and Slovenia, the data shows that the indicator is stable and higher than the Bulgarian level.

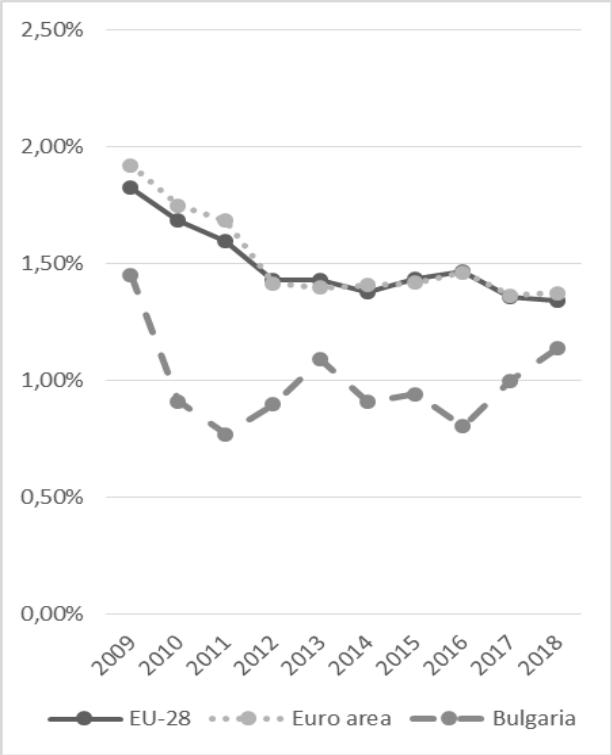

Fig. 4. *Share of intramural agricultural R&D expenditure in the Gross Value Added in the sector (%)*

Source: Eurostat, NSI

The results indicated that Bulgarian agricultural innovation system is facing major challenges and several steps should be done to overcome the emerging issues. Horizon 2020 and Common agricultural policy support R&D and innovation in agriculture. Horizon 2020 provides financial aid in five priority areas for research and innovation and also for clustered under two thematic headings. Measure 16 and LEADER approach under Pillar 2 are encouraging innovation, enhancing social capital and knowledge and information transfer (Shishkova, 2017).

Post-2020 Horizon Europe is involved with the funding of the agricultural innovation system. Bulgaria should improve the administrative capacity and benefit from the EU funds.

CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis some conclusions and recommendation could be drawn:

1. The results indicate the low share of R&D expenditures in the national GPD. Bulgaria is far below the self- the chosen level of 1.5% and should revise its targets.
2. The share of agricultural R&D expenditure is declining and Bulgaria is lagging behind the EU-28 average level.
3. Despite the high potential of Bulgarian agricultural innovation system, it is characterized by unclear priorities. There is no horizontal coordination in the system, which is working according to old sectoral policy structures, without operational horizontal coordination mechanism.
4. The new programming period 2021–2027 provides opportunities for financial support and Bulgaria should improve the funding instruments and coordination between ministries, agencies and other actors in the system.
5. The government should stimulate the highly skilled and educated human resources. Bulgarian scientist should be encouraged to participate in European programs and projects. Young people should be attracted to the field of agricultural science.
6. Support the public-private cooperation is another step toward the improvement of National agricultural innovation system. The collaboration between universities, research institutes, public organization and the enterprises could close the gap between research and business.

ACKNOWLEDGEMENTS

The results and their analyses in this paper are part of larger research under PhD project №D-39, finances by the Agricultural University – Plovdiv.

REFERENCES

Anandajayasekeram, P., 2011. The role of agricultural R&D within the agricultural innovation systems framework, Conference working paper 6, ASTI/IFPRI-FARA Conference, Accra, Ghana, 5–7 December, 2011.

Atanasov, D., Popova, B., 2010. Approaches to selection and integration of indicators for sustainable development of agriculture, Trakia Journal of Sciences, Vol. 8, Suppl. 3, pp. 133–139.

Bachev, H., Mihailova, M., 2019. Analysis of the State of the System of Sharing of Knowledge and Innovations in Bulgarian Agriculture) (May 31, 2019). Available at SSRN: https://ssrn.com/abstract=3397224 or http://dx.doi.org/10.2139/ssrn.3397224.

Bean, R., Radford, W., 2002. The Business of Innovation: Managing the Corporate Imagination for Maximum Results. New York: AMACOM.

Biggs, S., 1989. Resource-Poor Farmer Participation in Research: A Synthesis of Experiences from Nine National Agricultural Research Systems. OFCOR Comparative Study Paper. The Hague: International Service for National Agricultural Research.

Elliot, H., 2004. Systems Thinking, Commodity Chains and Agricultural Innovation Strategy. Entebbe: Association for Strengthening Agricultural Research in East and Central Africa.

Elliott, E., 2008. Evolution of Systems Thinking: Towards Agricultural ISs. Paper presented at the International Food Policy Research Institute conference "Advancing Agriculture in Developing Countries through Knowledge and Innovation," Addis Ababa, Ethiopia, April 7, 2008.

EU SCAR, 2012. Agricultural knowledge and innovation systems in transition – a reflection paper, Brussels.

Europe 2020 – A strategy for smart, sustainable and inclusive growth (Annex 1 – Overview)". EUR-Lex. European Commission. Retrieved 25, September 2015.

European Commission, 2015. Peer Review of the Bulgarian Research and Innovation system, Luxembourg: Publications Office of the European Union, 2015.

European Commission, 2016. Agricultural knowledge and innovation systems towards the future: A foresight paper, Luxembourg: Publications Office of the European Union, 2016.

Eurostat, Europe 2020 indicators – R&D and innovation, https://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_R%26D_and_innovation

Eurostat, Government support to agricultural research and development [SDG_02_30

Freeman, C., Soete, T., 1997. The Economics of Industrial Innovation, MIT Press Christensen.

Georgiev, M., Roycheva, A., 2017. New institutional economics and methods for measuring the adaptation of Bulgarian agriculture. Trakia Journal of Sciences, Vol. 15, Suppl. 1, pp. 199–205.

Hall, A., Mytelka, L. Oyeyinka, B., 2005. Implications for Agricultural Policy and Practice. ILCA Brief 2. Addis Ababa: International Livestock Centre for Africa.

Hristov, K., 2011. Institutional problems small farmers face when applying for assistance under the rural development program (2007–2013), Trakia Journal of Sciences, Suppl.3, Vol.9, pp. 83–87.

Klein Woolthuis, R., et al., 2005. A system failure framework for innovation policy design. Technovation 25, pp. 609–619.

Klerkx, L., Leeuwis, C., 2009. Establishment and embedding of innovation brokers at different innovation system levels: insights from the Dutch agricultural sector, in: Technological Forecasting & Social Change, 76: 849-860.

Leeuwis, C., Ban, A. v. d., 2004. Communication for rural innovation: Rethinking agricultural extension. Oxford Blackwell Science.

National Statistical Institute, R&D and Innovations, https://www.nsi.bg/en/content/6733/rd-and-innovations

OECD, 2013. Agricultural Innovation Systems: A Framework for Analysing the Role of the Government, OECD Publishing, Paris, https://doi.org/10.1787/9789264200593-en.

OECD/ Eurostat, 2005. Oslo Manual, Guidelines for Collecting and Interpreting Innovation Data, Paris: OECD.

Röling, N., Engel, P., 1991. IT from a knowledge system perspective: concepts and issues. Paper presented at the European Seminar on Knowledge Management and Information Technology, Wageningen.

Shishkova, M, 2017. Social Network Analysis of the Organizations Implementing Leader Approach in Bulgaria, Bulgarian Journal of Agricultural Economics and Management, Vol. 62, Issue 3, pp. 35–39.

Smits, R, Kuhlmann, S., Shapira, P., 2010. The Theory and Practice of Innovation Policy – An International Research Handbook, Edgar Elgar.